Imputation method to estimate landings and releases for Red Snapper (*Lutjanus campechanus*) in the South Atlantic region: maintaining MRIP proportions while utilizing data from specially designed surveys

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Imputation method to estimate landings and releases for Red Snapper (*Lutjanus campechanus*) in the South Atlantic region: maintaining MRIP proportions while utilizing data from specially designed surveys

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Background

Recreational fishing seasons for red snapper *(Lutjanus campechanus*) in the South Atlantic region have been extremely short since 2012, ranging between zero and nine days. As surveys developed to generate estimates at a monthly or annual scale (e.g. the State Reef Fish Survey [SRFS] and the Marine Recreational Information Program [MRIP]) are not well suited to sampling these shorter seasons, the most recent stock assessment for this fishery (i.e., SEDAR 73) used alternative data collection methods to help generate more accurate estimates of in-season landings for the recreational fishery. One such survey, the East Coast Red Snapper (ECRS) survey has been funded by the National Oceanic and Atmospheric Administration (NOAA) and run by the Florida Fish and Wildlife Conservation Commission (FWC) since 2012 (Ramsay and Corbett, 2025). In-season landing estimates from this survey were used to estimate red snapper landings for the recreational and charter fleets in FL in SEDAR 73 (SEDAR 73, 2020). South Carolina and Georgia also run specialized surveys for the charter fleet, which were used for charter catch estimates (SEDAR 73, 2020).

Additionally, since SEDAR 73, FWC's SRFS has been running for five years on the Atlantic coast of FL. This survey was developed in collaboration with NOAA Fisheries' MRIP to increase sampling for private recreational offshore trips for reef-associated species, which are relatively rare compared to all saltwater recreational fishing trips. To generate a complete timeseries (1981 to current) for the SRFS in Florida, a calibration method using the overlapping SRFS and MRIP timeseries was peer-reviewed (Ramsay, NOAA, *et al.* 2024). This allows the SRFS to be considered for use for out-of-season landings and releases of the private recreational fleet in Florida. SRFS has been approved for use in multiple stock assessments for reef-associated species that are landed predominately (~99%) in Florida: gulf Red Grouper (SEDAR 88), gulf Gag Grouper (SEDAR 72), mutton snapper (SEDAR 79), yellowtail snapper (SEDAR 96) and hogfish (SEDAR 94; Cross et al., 2020a, Ramsay et al., 2024a-c, Ramsay and McGirl 2025).

While SRFS and ECRS estimate private recreational catch in Florida, NOAA's MRIP survey is the primary data stream for the private recreational fleet for other states in this region, namely Georgia, South Carolina, and North Carolina. In SEDAR 73 the ECRS survey was used for in-season landings in Florida and MRIP was the predominate data source for all other private recreational data streams (SEDAR 73, 2020). MRIP, which is the primary collection method for saltwater recreational fishing data across the South Atlantic, is the only consistent data collection source across all states. MRIP estimates indicate that FL makes up 93 and 94% of the estimated landings and releases, respectively across the region. However, both SRFS and ECRS predict landings and releases are much lower than those estimated by MRIP. Therefore, there is concern about mixing these data streams and finalizing an assessment model where Florida makes up a much smaller proportion of total catch in the recreational fleet than is estimated by the MRIP survey. The method described below provides a method for using ECRS and SRFS catch estimates in Florida, while maintaining the proportions across states from the MRIP estimates.

Objectives

The objective is to provide a method to estimate private recreational landings and releases for the South Atlantic region (FL-NC). This method uses proportions of catch from MRIP and estimates from the specially designed ECRS survey (designed to estimate in-season landings for very short seasons) and the SRFS survey (designed to estimate catch for more rarely caught offshore species) to impute in Red Snapper (*Lutjanus campechanus*) catch for the rest of the region.

Methods

This analysis used private recreational estimates of total landings and releases in numbers of fish from the MRIP surveys across the South Atlantic region (NC to FL) from 1981-2025. All MRIP landings and release estimates used in this imputation method were generated by the NOAA Southeast Fisheries Science Center.

First, estimates across all states (s) in the region were summed to generate regional estimates for the whole period. Estimates ($\hat{E}$) and variances ($\hat{V}$) were summed across the region for all available years (1981-2025) and separately for each variable (v: number landed, number released) [1, 2].

$$\hat{E}_v = \sum_{v} \hat{E}_{y,s,v} \text{ [1]}$$

$$\hat{V}(\hat{E}_v) = \sum_{v} \hat{V}(\hat{E}_{y,s,v}) \text{ [2]}$$

Second, step one was repeated, but estimates were calculated separately for each variable and state (s). All years were again summed [3,4]

$$\hat{E}_{v,s} = \sum_{v,s} \hat{E}_{y,s,v} \text{ [3]}$$

$$\hat{V}(\hat{E}_{v,s}) = \sum_{v,s} \hat{V}(\hat{E}_{y,s,v}) \text{ [4]}$$

Third, proportions of landings and releases that occurred in each state from the region were calculated for each variable by dividing state estimates by the estimates for the whole region [4]. Variances were calculated using the delta method, incorporating the error of each state estimate and the error across the whole region.

$$\hat{P}_{v,s} = \frac{\hat{E}_{s,v}}{\hat{E}_v} \quad [4]$$

Fourth, to maintain the estimate proportions across the states from the MRIP survey while using the SRFS and ECRS estimates in Florida, state of Florida estimates (SRFS or ECRS) were divided by the proportion of landings or releases in FL to calculate an estimated number of landings or releases for the whole South Atlantic region [5].

$$\hat{E}_{y,v} = \frac{\hat{E}_{SRFS\ or\ ECRS,y,v}}{\hat{P}_{v,FLE}} \quad [5]$$

Variances were calculated using the delta method, incorporating the error of each state estimate and the error of the ratio. For all variance estimation using the delta method, a 0% correlation between the surveys was assumed as this is the most conservative approximation of variance, generating the highest variance estimates. ECRS estimates were used for in-season landings for the years that the mini-season was active (2012-2025). SRFS estimates were used for all releases and all other landings estimates. All computations were completed with the statistical software, R (R Core Team 2025).

Proportions were calculated by summing across all years. This was done after consideration of the potential for temporal trends in proportions calculated annually. Additionally, proportions calculated using finalized MRIP estimates were compared against proportions calculated using weighted access point angler intercept survey (APAIS) data. Proportions calculated in this way exclude any influence of the fishing effort survey (FES) data. APAIS data and the sample weights were provided by NOAA Office of Science and Technology (OS&T).

Results

There were no strong temporal trends for the proportion of landed or released (number of fish) red snapper caught by the private recreational fleet in the South Atlantic states between 1981-2025 (Fig. 1-2). Additionally, the error around the proportions calculated by year were large, with a mean PSE of 56% and a max PSE of 140% for landings and a median PSE of 48% and a max PSE of 140% for releases (Fig. 3-4). Therefore, proportions of catch in each state were calculated as a single proportion across all years (Table 1). Using MRIP catch estimates, red snapper were released 93% of the time in Florida, 3% of the time in Georgia and South Carolina and 1% of the time in North Carolina. Red snapper were landed 94% of the time in Florida, 4% of the time in Georgia, and 1% of the time in both South and North Carolina.

Estimated catch for the whole region were calculated (Tables 2-3, Fig. 5-6). Generated estimates rely on the assumption that SRFS or ECRS conducted in the other states would generate consistent proportions to those calculated with MRIP data. Estimates of landings and releases were consistently lower than those estimated by the MRIP survey across almost all years. The exceptions being that imputed landings were marginally higher than MRIP in 2012 and 2025.

PSE values averaged at 53% for landings and 43% for releases and incorporated error from the SRFS/ECRS estimates and MRIP proportion.

When comparing proportions calculated by finalized MRIP data and APAIS data, we found that Florida made up the vast majority of the catch in both instances (Table 4). APAIS showed 98% of releases in Florida and 97% of landings. While finalized MRIP estimates rely on APAIS data, they also incorporate estimates from the FES. This comparison further affirms that the proportions calculated using the MRIP estimates are an accurate depiction of the catch distribution across the region.

Acknowledgements

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References

Cross, Tiffanie A., Colin P. Shea, and Beverly Sauls. 2020b. A ratio-based method for calibrating GRFS and MRIP-FCAL estimates of total landings (numbers and pounds of fish), and releases (numbers of fish). SEDAR72-WP-04. SEDAR, North Charleston, SC. 10 pp.

R Core Team. 2025. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. http://www.R-project.org/

Ramsay, Chloe and Ellie Corbett. 2025. Florida East Coast Red Snapper (ECRS) Mini-Season Sampling. SEDAR90-DW-18. SEDAR, North Charleston, SC. 18 pp.

Ramsay, Chloe and Maria McGirl. 2025. A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), and releases (numbers of fish) from MRIP-FCAL to SRFS for Hogfish (Lachnolaimus maximus) in Florida. SEDAR94-DW-21. SEDAR, North Charleston, SC. 26 pp.

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, and Beverly Sauls. 2024a. A ratio-based method for calibrating MRIP-SRFS recreational fisheries estimates for southeastern US Mutton Snapper (Lutjanus analis). SEDAR79-AP02. SEDAR, North Charleston, SC. 17 pp.

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, and Beverly Sauls. 2024b. A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), releases (numbers of fish), and total trips from MRIP-FCAL to SRFS for Red Grouper (Epinephelus morio) in the Gulf of Mexico. SEDAR88-WP-17. SEDAR, North Charleston, SC. 14 pp.

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, and Beverly Sauls. 2024c. A ratio-based method for calibrating MRIP-SRFS recreational fisheries estimates for southeastern US Yellowtail Snapper (Ocyurus chrysurus). SEDAR96-WP-05. SEDAR, North Charleston, SC. 14 pp.

Ramsay, Chloe, Tiffanie A. Cross, Colin P. Shea, Beverly Sauls, Lynn Stokes, Robert Ahrens, Evan Howell, Clay Porch, Andy Strelcheck. 2024. (Ramsay, NOAA OS&T 2024). Certification Review of Florida's Proposed MRIP-SRFS Calibration Methodology for Mutton and Yellowtail Snapper. SEDAR79-RD-09, 50pp. https://sedarweb.org/documents/sedar-rd09-certification-review-of-floridas-proposed-mrip-srfs-calibration-methodology-for-mutton-and-yellowtail-snapper/

Red Snapper Mini-Season Ad-hoc Working Group. 2020. SEDAR 73 South Atlantic Red Snapper Mini-Season Ad-hoc Group Call. SEDAR73-WP10. SEDAR, North Charleston, SC. 5 pp.

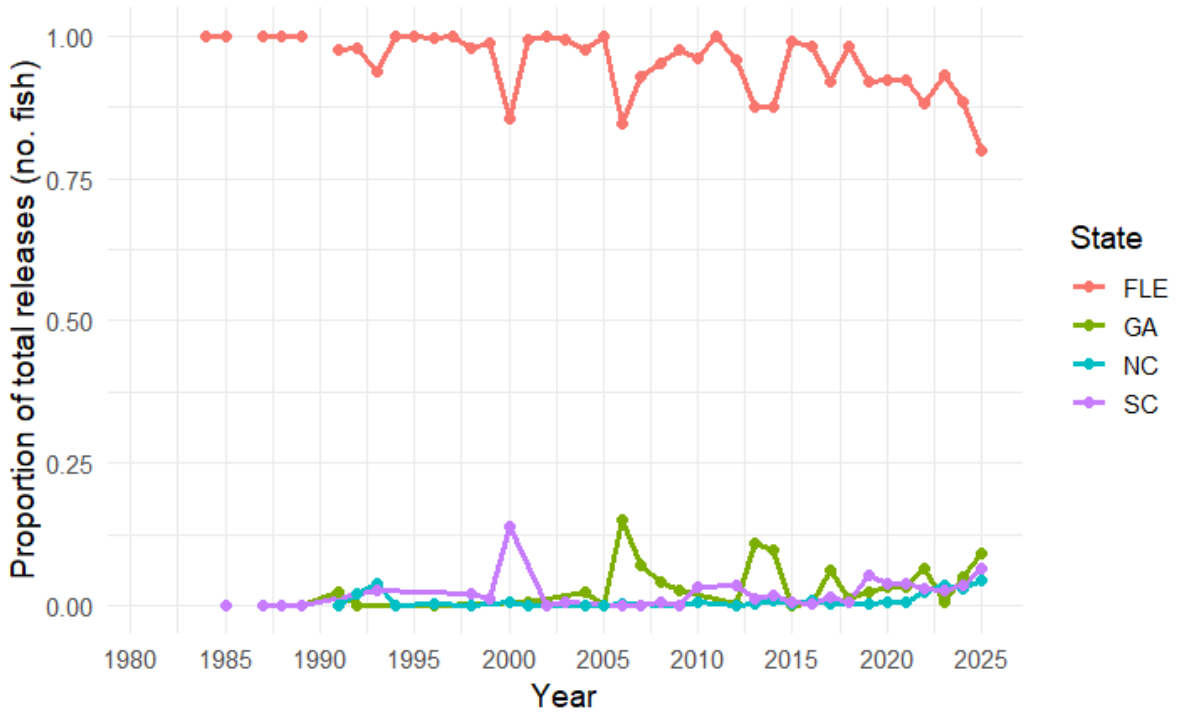

Figure 1. The proportion of the total estimated released red snapper (number of fish) by the private recreational fleet between 1981-2025 by state across all states in the South Atlantic region. Estimates are generated using the MRIP survey. Missing points depict years where no red snapper were intercepted by dockside samplers.

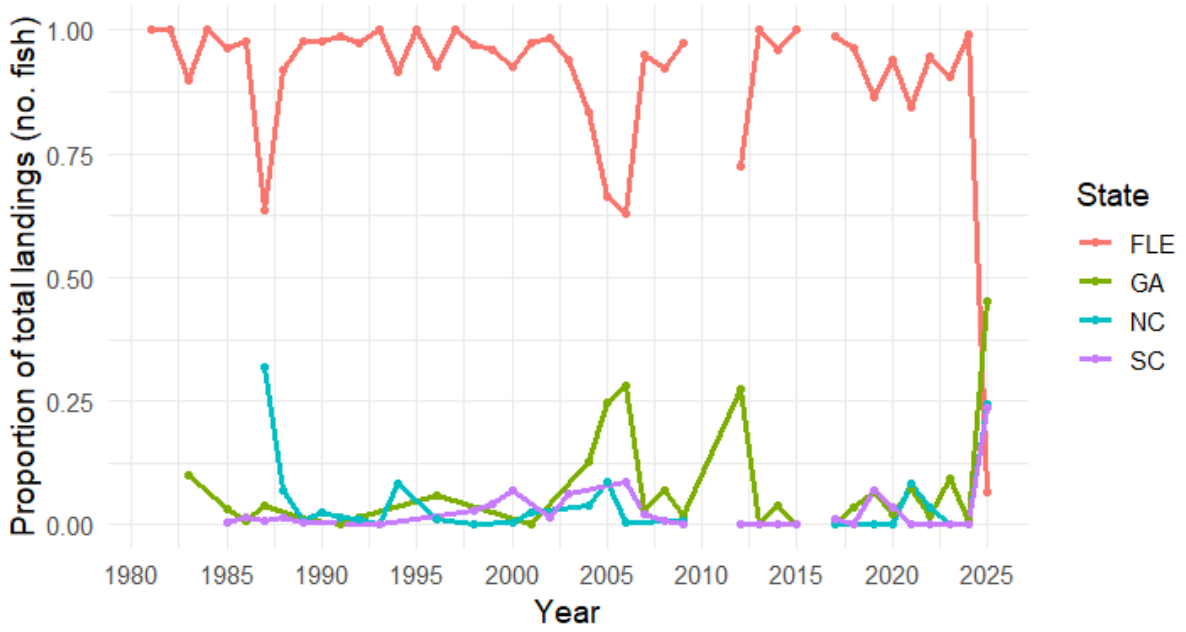

Figure 2. The proportion of the total estimated landed (number of fish) red snapper *(Lutjanus campechanus*) by the private recreational fleet between 1981-2025 by state across all states in the South Atlantic Region. Estimates are generated using the MRIP survey. Missing points depict years where no red snapper were intercepted by dockside samplers.

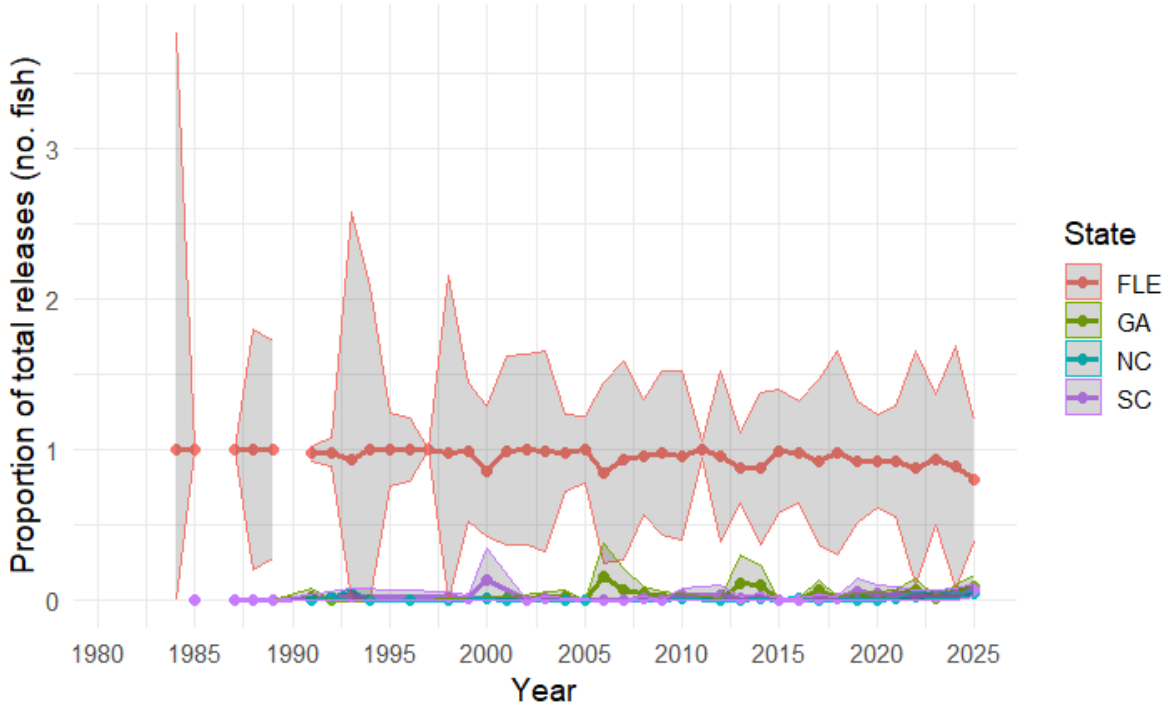

Figure 3. The proportions and the error around the annual proportions of the total estimated released (number of fish) red snapper *(Lutjanus campechanus*) by the private recreational fleet between 1981-2025 by state across all states in the South Atlantic Region. Estimates are generated using the MRIP survey. Missing points depict years where no red snapper were intercepted by dockside samplers. Error depicts 95% confidence intervals and was calculated using the delta method. It incorporates error around both state and regional estimates.

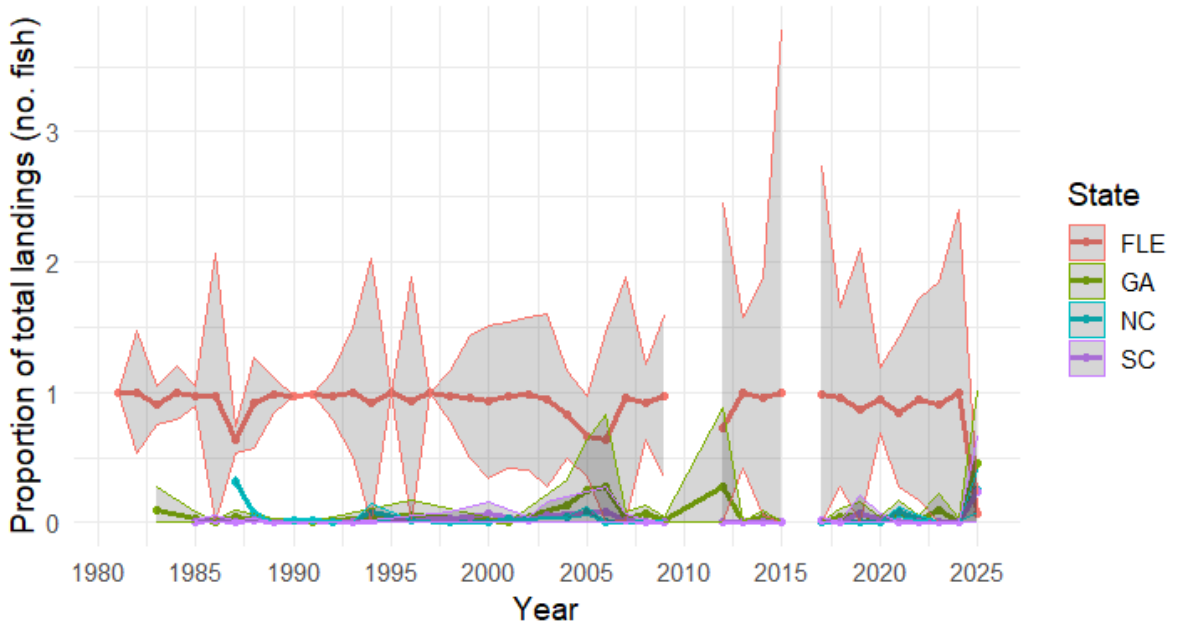

Figure 4. The proportions and the error around the annual proportions of the total estimated landed (number of fish) red snapper *(Lutjanus campechanus*) by the private recreational fleet between 1981-2025 by state across all states in the South Atlantic Region. Estimates are generated using the MRIP survey. Missing points depict years where no red snapper were intercepted by dockside samplers. Error depicts 95% confidence intervals and was calculated using the delta method. It incorporates error around both state and regional estimates.

Table 1. Landings and release (number of fish) estimates for the private recreational fleet from the marine recreational information program (MRIP) for red snapper *(Lutjanus campechanus*) were summed from 1981-2025 and proportions were calculated for each state in the South Atlantic.

	Releases (no. fish)	Releases Variance	Release Proportion	Landings (no. fish)	Landings Variance	Landing Proportion
FLE	18,661,960	1,175,039,664,034	0.92738	3,181,141	57,379,584,421	0.93582
GA	693,511	11,651,128,034	0.03446	133,315	930,385,655	0.03922
NC	238,918	736,009,323	0.01187	38,343	186,494	0.01128
SC	528,908	12,478,389,203	0.02628	46,506	214,660,397	0.01368
Total	20,123,297	1,199,905,190,594		3,399,305	58,524,816,967	

Table 2. Estimated number of released red snapper *(Lutjanus campechanus*) and their PSE values between 1981-2025. Estimates shown are from MRIP and the imputed option (imputed) for the whole South Atlantic region (FL-NC) and for SRFS for Florida only. Estimates are for the private recreational fleet.

	Releases (no. fish)					
	MRIP		Imputed		SRFS (FL only)	
Year	Estimate	PSE	Estimate	PSE	Estimate	PSE
1981	0	NA	0	NA	0	NA
1982	0	NA	0	NA	0	NA
1983	0	NA	0	NA	0	NA
1984	5,831	1.00	4,360	1.02	4,043	1.01
1985	27,655	0.00	20,675	0.87	19,174	0.87
1986	0	NA	0	NA	0	NA
1987	52,154	0.00	38,990	0.76	36,159	0.76
1988	23,959	0.29	17,912	0.50	16,611	0.49
1989	12,045	0.26	9,005	0.54	8,351	0.54
1990	0	NA	0	NA	0	NA
1991	22,633	0.03	16,508	0.59	15,309	0.59
1992	12,288	0.03	9,002	0.51	8,348	0.50
1993	37,065	0.61	25,965	0.71	24,079	0.70
1994	59,804	0.39	44,710	0.51	41,463	0.50
1995	25,136	0.09	18,792	0.42	17,427	0.41
1996	22,477	0.08	16,757	0.86	15,540	0.86
1997	6,516	0.00	4,871	0.50	4,517	0.49
1998	22,197	0.43	16,230	0.53	15,051	0.52
1999	79,870	0.17	58,970	0.33	54,688	0.32
2000	222,679	0.19	142,416	0.35	132,074	0.34
2001	136,364	0.23	101,284	0.34	93,929	0.33
2002	96,996	0.23	72,485	0.35	67,221	0.34
2003	123,764	0.24	91,906	0.37	85,232	0.36
2004	212,580	0.09	154,984	0.31	143,729	0.30
2005	39,000	0.08	29,157	0.35	27,040	0.35
2006	136,430	0.25	86,435	0.38	80,158	0.37
2007	537,236	0.25	373,031	0.36	345,942	0.35
2008	679,617	0.14	483,395	0.35	448,291	0.34
2009	357,507	0.20	260,419	0.31	241,508	0.30
2010	189,580	0.21	136,137	0.36	126,251	0.35
2011	124,736	0.02	93,254	0.59	86,482	0.59
2012	222,909	0.21	159,846	0.41	148,238	0.40
2013	143,203	0.12	93,764	0.40	86,955	0.39
2014	478,785	0.20	313,054	0.32	290,320	0.31
2015	705,245	0.15	522,134	0.41	484,217	0.40
2016	1,421,168	0.12	1,044,363	0.30	968,522	0.29
2017	821,534	0.21	565,439	0.31	524,377	0.30

2018	2,118,707	0.25	1,555,351	0.32	1,442,403	0.31
2019	1,381,418	0.16	949,437	0.32	880,490	0.31
2020	2,190,586	0.12	1,510,973	0.34	1,401,247	0.33
2021	1,541,724	0.14	1,397,040	0.21	1,295,588	0.19
2022	1,565,925	0.30	944,022	0.26	875,468	0.25
2023	1,458,806	0.16	801,235	0.15	743,050	0.12
2024	1,889,078	0.31	1,096,286	0.14	1,016,675	0.11
2025	918,092	0.17	671,371	0.16	622,617	0.14

Table 3. Estimated number of landed red snapper *(Lutjanus campechanus*) and their PSE values between 1981-2025. Estimates shown are from MRIP and the imputed option (imputed) for the whole South Atlantic region (FL-NC) and for SRFS for Florida only. Estimates are for the private recreational fleet.

	Landings (no. fish)					
	MRIP		Imputed		SRFS/ECRS (FL only)	
Year	Estimate	PSE	Estimate	PSE	Estimate	PSE
1981	138,440	0.00	55,435	0.63	51,877	0.63
1982	25,849	0.17	10,350	0.59	9,686	0.58
1983	18,275	0.09	6,588	1.08	6,165	1.07
1984	84,032	0.08	33,649	0.57	31,489	0.56
1985	126,316	0.03	48,772	0.68	45,642	0.67
1986	51,313	0.40	20,055	0.69	18,768	0.68
1987	34,218	0.05	8,705	0.62	8,146	0.61
1988	42,484	0.13	15,624	0.60	14,621	0.59
1989	92,981	0.05	36,404	0.59	34,068	0.58
1990	4,569	0.00	1,787	0.66	1,672	0.66
1991	22,364	0.00	8,832	0.84	8,265	0.84
1992	23,391	0.07	9,126	0.60	8,540	0.59
1993	7,583	0.18	3,037	0.56	2,842	0.55
1994	11,305	0.42	4,151	0.68	3,885	0.67
1995	1,825	0.00	731	0.71	684	0.71
1996	9,402	0.36	3,491	0.70	3,267	0.69
1997	2,675	0.00	1,072	0.78	1,003	0.77
1998	5,247	0.07	2,041	0.57	1,910	0.56
1999	18,645	0.18	7,164	0.51	6,704	0.50
2000	62,833	0.22	23,343	0.51	21,845	0.50
2001	35,155	0.20	13,729	0.48	12,848	0.47
2002	30,574	0.21	12,066	0.48	11,292	0.47
2003	13,652	0.25	5,133	0.50	4,804	0.49
2004	30,123	0.15	10,051	0.51	9,406	0.50
2005	17,925	0.20	4,772	0.57	4,466	0.56
2006	20,636	0.42	5,201	0.67	4,867	0.66

2007	33,875	0.35	12,900	0.56	12,072	0.55
2008	161,368	0.11	59,554	0.50	55,732	0.49
2009	161,347	0.23	62,939	0.48	58,900	0.47
2010	0	NA	0	NA	0	NA
2011	0	NA	0	NA	0	NA
2012	10,460	0.74	12,009	0.19	11,238	0.15
2013	43,463	0.21	7,479	0.22	6,999	0.19
2014	157,033	0.33	24,723	0.16	23,136	0.13
2015	899	1.00	360	1.08	337	1.07
2016	0	NA	0	NA	0	NA
2017	60,820	0.64	10,811	0.51	10,117	0.50
2018	480,646	0.25	33,260	0.23	31,125	0.20
2019	151,482	0.48	40,339	0.20	37,750	0.17
2020	444,662	0.10	33,042	0.21	30,921	0.19
2021	70,020	0.23	40,282	0.17	37,697	0.14
2022	110,118	0.29	21,000	0.27	19,652	0.25
2023	303,935	0.36	52,526	0.25	49,155	0.23
2024	251,926	0.51	31,376	0.41	29,362	0.39
2025	25,439	0.33	25,788	0.30	24,133	0.28

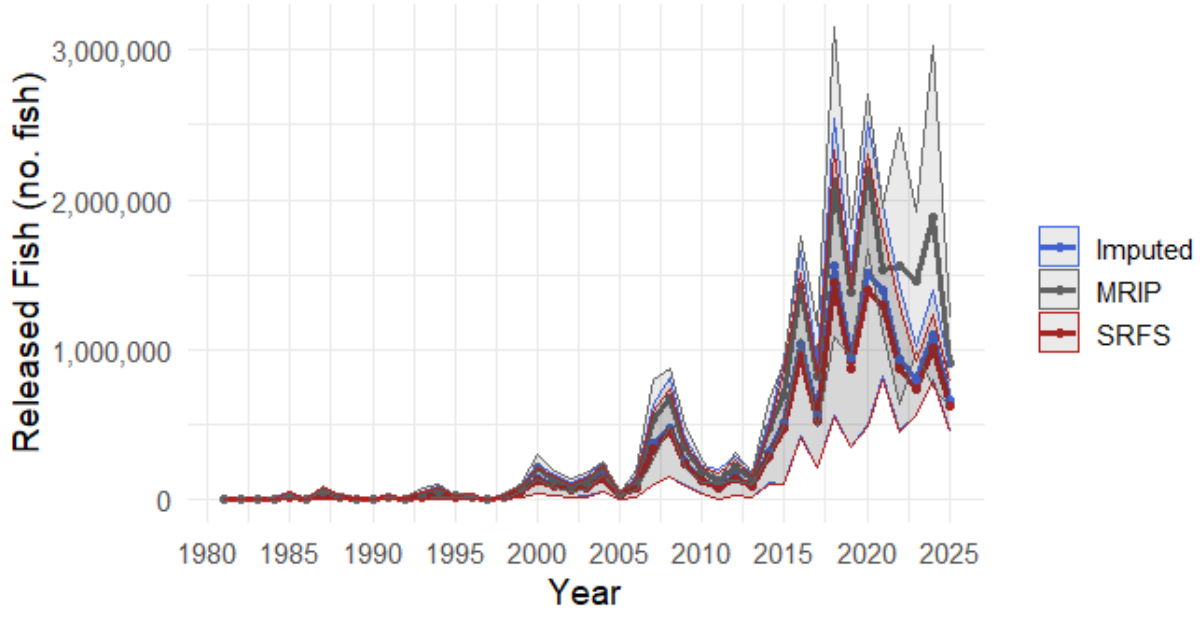

Figure 5. Released (number of fish) red snapper *(Lutjanus campechanus*) estimated by the imputation option (imputed) and MRIP for the private recreational fleet for the south Atlantic region and in Florida only from SRFS. Error depicts 95% confidence intervals.

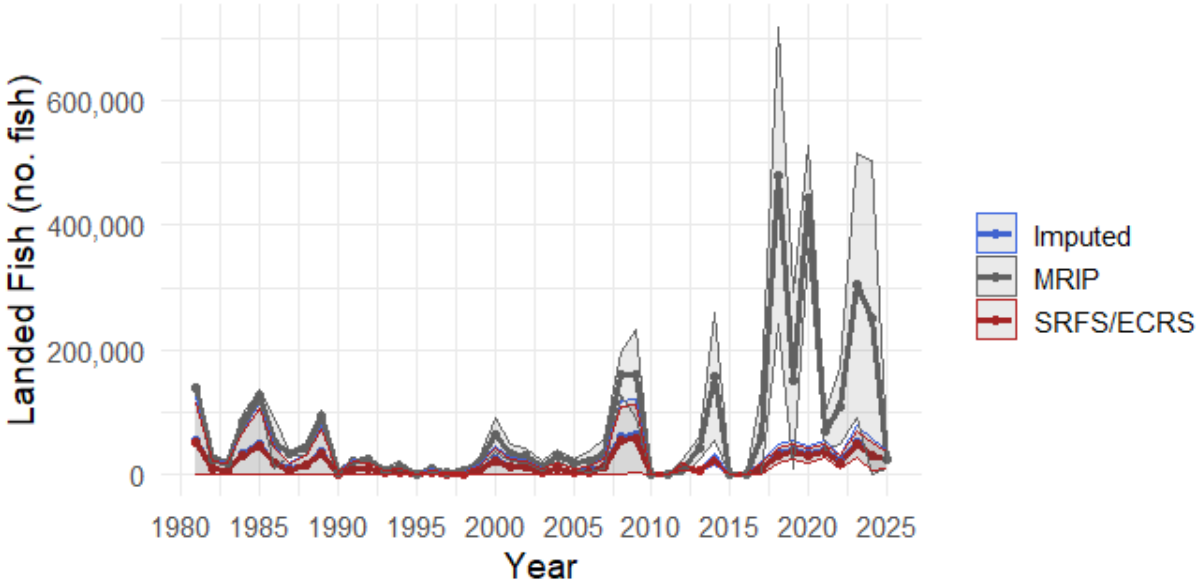

Figure 6. Landings (number of fish) of red snapper *(Lutjanus campechanus*) estimated by the imputation option (imputed) and MRIP for the private recreational fleet for the south Atlantic region are shown. Estimates from Florida only from SRFS before 2012 and for out of season landings and from ECRS for in season landings between 2012-2025 are also shown. Error depicts 95% confidence intervals.

Table 4. Proportions of caught red snapper *(Lutjanus campechanus*) for each state were calculated by summing estimates of landings and releases (number of fish) across all years (1981-2025) for each state. Proportions were calculated using finalized MRIP estimates (used in the final imputation results) and compared against proportions calculated using weighted access point angler intercept survey (APAIS) data. Weighted APAIS data excludes the influence of the fishing effort survey (FES).

	Releases (no. fish)		Landings (no. fish)	
	Weighted APAIS	Finalized MRIP	Weighted APAIS	Finalized MRIP
FLE	0.9847506	0.927381	0.971409	0.935821
GA	0.0060026	0.034463	0.009856	0.039218
NC	0.0006126	0.011873	0.009444	0.01128
SC	0.0086342	0.026283	0.009291	0.013681